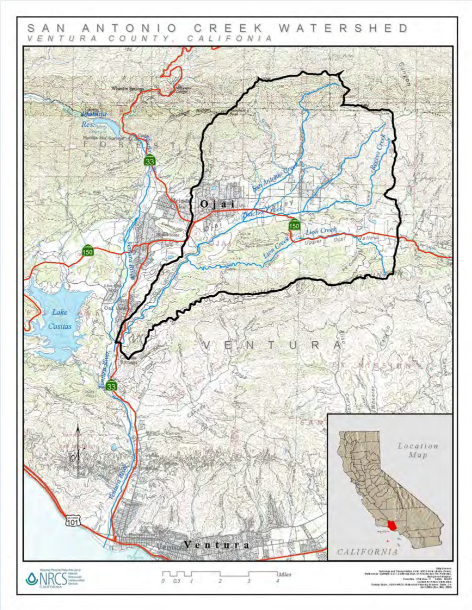
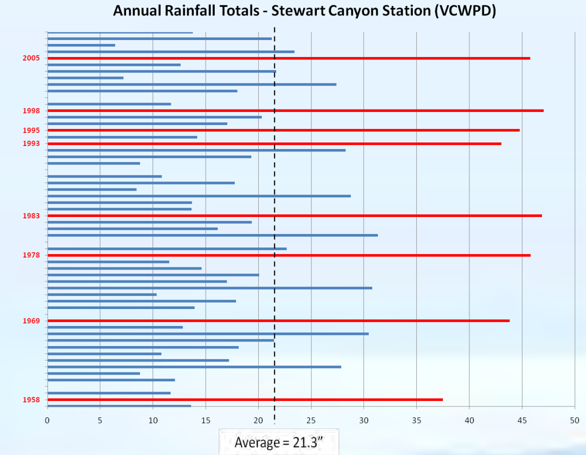
Debris Production and Flood Hazard Evaluation for Planning: San Antonio Creek Watershed, Ventura County, California

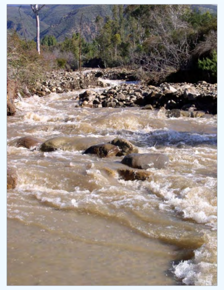
By Julia Grim, Geologist and Greg Norris, Hydraulic Engineer, Davis, California





Ojai Valley Flooding January 7-11, 2005

13.93" in 4 days at Stewart Canyon



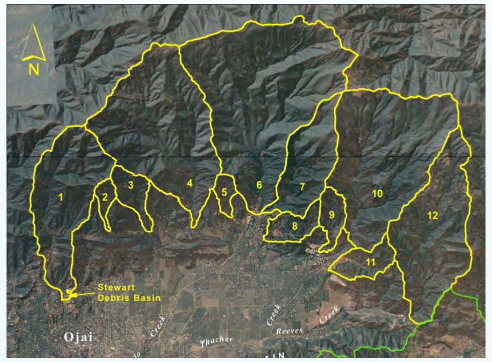
Flood Hazard Evaluation:

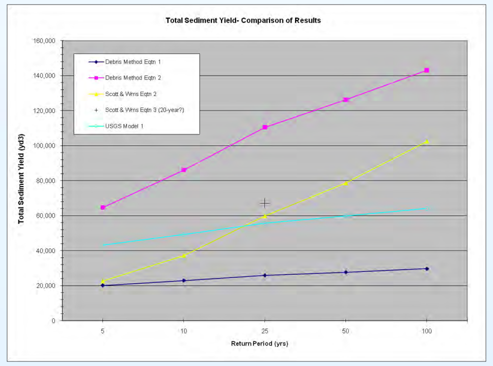
- Debris yield estimation
- Approximated 100 year flood plain
- Focus on agricultural and rural residential properties

Debris Yield Estimates from Southern California Uplands:

- Event-based estimates of debris yield from upland subwatersheds
- Using four methods.
- The 100-year debris-yield event (Scott and Williams, 1978) used to estimate flow bulking as an input into the floodplain mapping model.

Stream channels: sediment deposition patterns



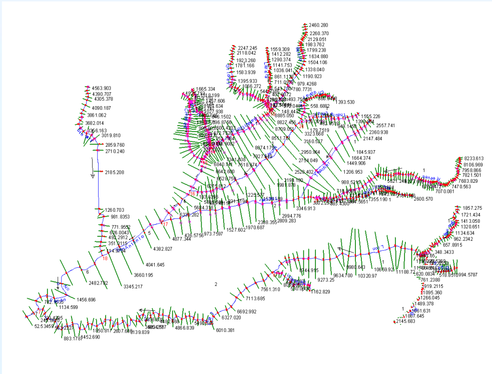


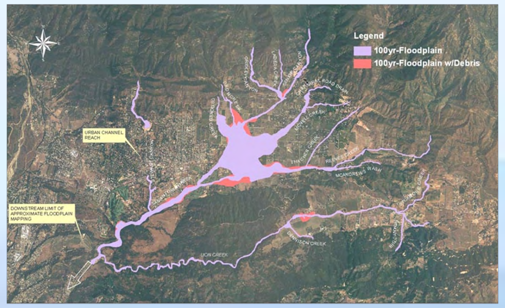
SUMMARY OF RESULTS USING SCOTT AND WILLIAMS' EQUATION 2

Subwatershed (sorted smallest to largest)	Area	5-Year		10-year		25-year		50-year		100-year	
		Total Sediment Yield (S_{y2}) (rounded)	Unit Sediment Yield (S_{y2}/A_m)	Total Sediment Yield (S_{y2}) (rounded)	Unit Sediment Yield (S_{y2}/A_m)	Total Sediment Yield (S_{y2}) (rounded)	Unit Sediment Yield (S_{y2}/A_m)	Total Sediment Yield (S_{y2}) (rounded)	Unit Sediment Yield (S_{y2}/A_m)	Total Sediment Yield (S_{y2}) (rounded)	Unit Sediment Yield (S_{y2}/A_m)
	mi^2	yd^3	yd^3/mi^2	yd^3	yd^3/mi^2	yd^3	yd^3/mi^2	yd^3	yd^3/mi^2	yd^3	yd^3/mi^2
Crooked	0.14	1,700	12,316	2,800	20,308	4,500	32,823	6,000	43,913	7,700	57,005
Ladera	0.15	2,200	14,326	3,600	23,621	5,700	37,596	7,700	50,738	10,300	67,736
McNell	0.28	2,300	8,164	3,800	13,461	6,300	22,279	8,500	30,067	10,900	38,475
Dron	0.33	4,300	13,064	7,000	21,542	11,300	34,451	15,000	45,839	19,300	59,241
Chaparral Rd	0.33	2,000	6,129	3,300	10,106	5,600	17,106	7,300	22,247	9,600	29,521
West Black Mtn	0.35	4,000	11,203	6,500	18,473	10,500	29,852	14,100	40,029	18,400	52,057
Firebreak Rd	0.38	2,700	7,243	4,500	11,943	7,300	19,448	10,000	26,489	12,300	32,651
Upper Lion	0.71	7,700	10,840	12,700	17,874	21,300	29,910	28,200	39,642	36,400	51,073
East Senior	1.11	12,600	11,350	20,800	18,715	33,300	29,871	45,200	40,558	58,400	52,416
Big Canyon	1.14	12,900	11,320	21,200	18,665	35,700	31,411	48,600	42,782	61,200	53,918
Stewart	1.88	22,600	11,985	37,200	19,761	59,800	31,741	78,600	41,692	102,500	54,371
Reeves	2.25	24,600	10,915	40,600	17,997	68,900	30,574	90,700	40,228	118,300	52,461
Gridley	3.20	58,900	18,440	97,200	30,405	157,000	49,106	208,000	65,060	281,000	87,888
Thacher	3.23	41,400	12,804	68,200	21,112	115,200	35,648	152,100	47,077	202,100	62,553
Senior	4.50	79,600	17,686	131,200	29,162	214,300	47,633	282,200	62,721	390,900	86,862
Average (rounded)			12,000		20,000		32,000		43,000		56,000
SUBTOTAL (rounded)	20.0	280,000		461,000		757,000		1,002,000		1,339,000	

FLOODPLAIN MAPPING METHODOLOGY

- Used US Army Corps of Engineers Study to assign peak flows to major streams
- Used 2009 NRCS calculations, Engineering Field Handbook Chapter 2, NRCS curve number method to assign peak flows to tributaries
- Ran HEC-RAS model using bulked flows and LIDAR based cross sections
- Applied GIS based LIDAR data to develop cross-sectional data using HEC-GeoRAS





View of Ojai Valley, San Antonio Watershed (Ventura County, California)

Based on a presentation to the JOINT FEDERAL INTERAGENCY CONFERENCE, June-July 2010, Las Vegas NV.

The full report, "The San Antonio Creek Watershed: an agricultural and rural residential land protection study" is posted on the California NRCS sharepoint site, and a pdf copy can be obtained by contacting Steve Hill, Natural Resource Manager, Resource Technology Staff, USDA NRCS, 430 G Street, Davis CA 95616 (530-792-5642, or steve.hill@ca.usda.gov)

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DEBRIS PRODUCTION AND FLOOD HAZARD EVALUATION FOR PLANNING, SAN ANTONIO CREEK WATERSHED, VENTURA COUNTY, CALIFORNIA

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San Antonio Creek drains approximately 50 square miles in the Ventura River Basin in western Ventura County, California. Recurring floods along San Antonio Creek and its tributaries, including Lion, Reeves, and Thacher Creeks, have resulted in millions of dollars in damages in Upper Ojai and Ojai Valleys, and in the canyon downstream. The Ventura County Watershed Protection District (VCWPD), in partnership with the Natural Resources Conservation Service (NRCS) and Ventura County Resource Conservation District, developed an approximated floodplain map as part of ongoing efforts to reduce flood-related damages to agricultural and rural residential properties. This presentation discusses the procedure used for developing the floodplain map, including the application of empirical equations developed by others to estimate sediment/debris production from upland subwatersheds.

Sediment and debris production and yield from the steep uplands in the San Antonio Creek watershed, directly and significantly contribute to the flood hazard by bulking stormflows. Sediment/debris production rates vary over time, and are significantly greater following wildfire and large (high intensity and/or duration) storm events. Numerous empirical equations for estimating sediment yield have been developed using cleanout data collected from debris basins in Los Angeles and Ventura counties (including the Stewart Debris Basin located in the San Antonio Creek watershed). These equations are most appropriately applied to estimate sediment production from the steep upland watersheds (i.e. supply-limited sedimentation processes). For flood-hazard and sedimentation analyses, sediment yield estimates made using one or more of these equations may be input as point loads into models that characterize transport-limited processes for bedload and suspended sediment transport through lower-gradient valleys

For this evaluation, five empirical equations from three published reports were applied and compared to estimate event-based sediment yield rates to the bases of selected upland subwatersheds in the San Antonio Creek watershed (Scott and Williams, 1978; Gatwood et. al, 2000; Gartner et. al, 2009). An Excel© spreadsheet was developed that allows the user to enter equation-specific parameters and readily compare results. Results of applying the different equations to the 15 upland subwatersheds, assuming current cover and hydrologic conditions, were highly variable, and as a group, inconclusive. Factors that likely contribute to the large variation include: 1) spatial and temporal variations in sediment production, transport, and yield; 2) limitations and large margins of error associated with available data; and 3) at least four of the five equations include inputs that are notably subjective, insufficiently documented, and difficult to reproduce. For this evaluation, results using Equation 2 by Scott and Williams (1978) were chosen as a reasonable characterization of sediment yield to the bases of the upland subwatersheds.

For the flood hazard analysis, sediment yield estimates as a function of subwatershed drainage area were compared to a family of empirically-generated curves developed by the Los Angeles County Department of Public Works (1993), to estimate a sediment bulking factor. Stormflows for each stream reach, estimated using NRCS hydrologic modeling tools and published data, were bulked by a factor of 1.6 to represent the runoff and sediment moving through the system.

A HEC-RAS model was developed to delineate inundation areas within the watershed for a 100-year storm. Model inputs, including bulked stormflow estimates and channel cross-sections generated using LIDAR data obtained from the VCWPD, were imported into the GIS-based platform, which then ran the HEC-RAS model and delineated the estimated inundation areas onto topographic map and orthophoto bases. This information will be used to identify alternatives for protecting agricultural and rural residential properties that have potential for flooding during a 100-year storm event.

REFERENCES

Gartner, J.E., Cannon, S.H., and Helsel, D.R. (2009). "Multivariate statistical models for predicting sediment yields from southern California watersheds," U.S. Geological Survey Open-File Report 2009-1200, 42 p., http://pubs.er.usgs.gov/usgspubs/ofr/ofr20091200.

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Los Angeles County Department of Public Works (1993). Sedimentation Manual. Hydraulic/Water Conservation Division, Los Angeles, CA. http://ladpw.org/wrd/publication/Engineering/online/Contents/SEDMST.pdf.

Scott, K.M., and Williams, R.P. (1978). "Erosion and sediment yields in the Transverse Ranges, southern California," U.S. Geological Survey Professional Paper 1030, 38 p., http://pubs.er.usgs.gov/usgspubs/pp/pp1030.

Abstract to the proceedings of the JOINT FEDERAL INTERAGENCY CONFERENCE 2010, Hydrology and Sedimentation for a Changing Future: Existing and Emerging Issues. The 4th Federal Interagency Hydrologic Modeling Conference and the 9th Federal Interagency Sedimentation conference, Las Vegas, NV, June 27—July 1, 2010.

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